ASIAEX, East China Sea
Cruise Report of the Activities of the R/V *Melville*
29 May to 9 June 2001

by Peter H. Dahl

Technical Memorandum

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Applied Physics Laboratory University of Washington
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ACKNOWLEDGMENTS

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It has been two years since the ASIAEX meeting in Alaska, during which the genesis of the East China Sea experiment occurred. It is clear that the early, dedicated effort put into the ASIAEX program by the late Warren Denner has paid off, and we all remain grateful for his work.

It has truly been a pleasure to work with my fellow PIs on this cruise, Bill Hodgkiss (MPL-SIO), Jim Miller (URI), and Dajun Tang (APL-UW). Speaking for us all, I thank the other team members, Dick Harris, Jeff Skinner, and Dave Ensberg (MPL-SIO), and Gopu Potty (URI), who did a splendid job in carrying out the experimental objectives of MPL-SIO and URI, and eagerly pitched in to help on the many cooperative tasks.

I would like to personally thank the APL-UW team, Russ Light, Vern Miller, Pete Sabin, and Eric Boget, who worked tirelessly to successfully carry out my experimental objectives and those of Dajun Tang, as well as pitched in on the cooperative tasks including deployment of the HAARI and 'Yellow Sea' arrays. I also wish to thank Lee Culver (ARL-PSU) for kindly loaning me the wave buoy used during this experiment.

Many thanks to Captain Dave Murline and the crew of the R/V *Melville*, who did an absolutely superb job in carrying out our experimental objectives, while also protecting our moorings from the fishing traffic pressure that was "24/7". I want to thank Shad Baiz, the SIO resident technician, for his amazing deck work while deploying and recovering gear for all the science teams, and Ron Moe, the SIO computer technician, who speedily and expertly satisfied all our computer network needs. I also want to thank Captain Tom Althouse, and the entire MARFAC organization of SIO, for really going to bat for the ASIAEX program in order to get the *Melville* back into the experiment after the problem with its z-drive shaft occurred. The R/V *Melville* was indeed *the* ship for this job!

Finally, many thanks to all of our colleagues from the People's Republic of China. It is not easy to coordinate the schedules of three ships, and the efforts by the South China Sea Institute of Oceanography to make available the research vessels *Shi Yan 2* and *Shi Yan 3* are much appreciated. I thank Rehne Zhang, the Chief Scientist on board the *Shi Yan 3*, and Jixun Zhou for all their efforts to work out the details of this experiment. Many thanks to Jin Yan of the Institute of Acoustics, Beijing, for his outstanding work as liaison scientist for ASIAEX.

ABSTRACT

Science teams from APL-UW, MPL-SIO, and URI deployed a constellation of instruments from the R/V *Melville* to measure acoustic propagation and scattering over a broad frequency range (100 Hz to 20 kHz), and environmental acoustic variables in the East China Sea (ECS). This work was completed from 29 May 2001 to 9 June 2001 as part of the Asian Seas International Acoustics Experiment (ASIAEX). From 2 to 5 June, operations from the *Melville* were coordinated with those of the Chinese research vessels *Shi Yan 2* and *Shi Yan 3* in order to conduct studies in wide-band propagation and reverberation using explosive charges deployed from both Chinese vessels. The ASIAEX ECS 2001 experiment produced a remarkable set of measurements on acoustic propagation and scattering in an Asian littoral sea, along with environmental measurements required for its interpretation.

1. INTRODUCTION

This report provides an overview of the experimental work conducted from the R/V *Melville*, while operating in the East China Sea (ECS) from 29 May to 9 June 2001 as part of the Asian Seas International Acoustics Experiment (ASIAEX).

ASIAEX is a scientific collaboration, with primary sponsorship from the US Office of Naval Research, and involves the United States, the People's Republic of China, Taiwan, Korea, Japan, Russia, and Singapore. The main goal of ASIAEX is to contribute to a more fundamental understanding of ocean acoustic propagation and scattering in shallow-water regions while fostering cooperative research among Pacific Rim nations. Two major field experiments were completed in 2001. The first experiment was conducted in the South China Sea with a focus on acoustic cross-shelf propagation. The second experiment, reported here, was conducted in the East China Sea (ECS) and focused on shallow water acoustic propagation and boundary scattering in an Asian littoral environment.

Science teams from the Applied Physics Laboratory-University of Washington (APL-UW), Marine Physics Laboratory-Scripps Institution of Oceanography (MPL-SIO), and the University of Rhode Island (URI) deployed a constellation of instruments from the R/V *Melville* to measure acoustic propagation and scattering over a broad frequency range (100 Hz to 20 kHz). Environmental measurements were also made; they included sound speed as a function of depth, sea surface wave spectra, and seabed parameters. In addition, a team from the Hangzhou Applied Acoustics Research Institute (HAARI), working with APL-UW, measured bottom reverberation at 3.5 kHz (these measurements are discussed elsewhere).

A key phase of the ECS experiment occurred from 2 to 5 June. During this period, the measurement schedule for the R/V *Melville* was coordinated with that of Chinese research vessels *Shi Yan 2* and *Shi Yan 3*. Ship operations were coordinated to conduct studies in wide-band propagation and reverberation. *Shi Yan 2* and *Shi Yan 3* deployed 38-g and 1000-g explosive charges, known as wide-band sources (WBS) and data were recorded on arrays deployed from the *Melville* and *Shi Yan 3* (examples of the *Melville* data are discussed below).

Heavy fishing traffic (see Figure 1) was a constant factor in the daily operations of this experiment. Jin Yan and Zhongkang Wang, both from the P. R. China, were often requested to come up to *Melville*'s bridge and advise fishing vessels to stay clear of our moorings (using radio channel 16). There was never any evidence that these communications were heeded.

Figure 1. Photograph of a particularly close encounter with a Chinese fishing vessel (Jeff Skinner, MPL-SIO). Note the trawl cables streaming aft of the vessel.

A vigilant watch was kept by the crew of the *Melville*, which paid off insofar as all experimental objectives were met and all equipment was recovered. But the *Shi Yan 3* lost its horizontal array, presumably because the recovery line was cut by a trawl wire. After confirming the loss with the *Shi Yan 3* via fax, we spent about 3 h on our last day on site grappling for the lost equipment without success. The polypropelene mooring line for the wave buoy (deployed by APL-UW and discussed below) was also cut by a trawl wire. Fortunately, the buoy was seen to be out of position and was immediately recovered (two days before its scheduled recovery) without loss of mooring hardware or damage. The high fishing traffic forced the research team to make minor modifications to measurement plans (e.g., shortening the time for a particular measurement, or reducing the distance between the *Melville* and a particular mooring). However, these changes did not prevent us from achieving our overall scientific measurement goals.

As planned, for the majority of time on site the *Melville* operated within 1 n mi of the nominal position 29 39N, 126 49E (water depth 105 m), or at the center of the 30-km radius circle (Figure 2). Any movement within the 1 n mi radius was by design, e.g., to move closer to or farther from a particular mooring. The *Melville* held station using its dynamic positioning system. This proved to be an excellent means for station keeping while conducting acoustic measurements in an environment with rather high ambient noise levels associated with shipping and fishing vessels; it also eliminated the need for a risky and time consuming anchoring procedure.

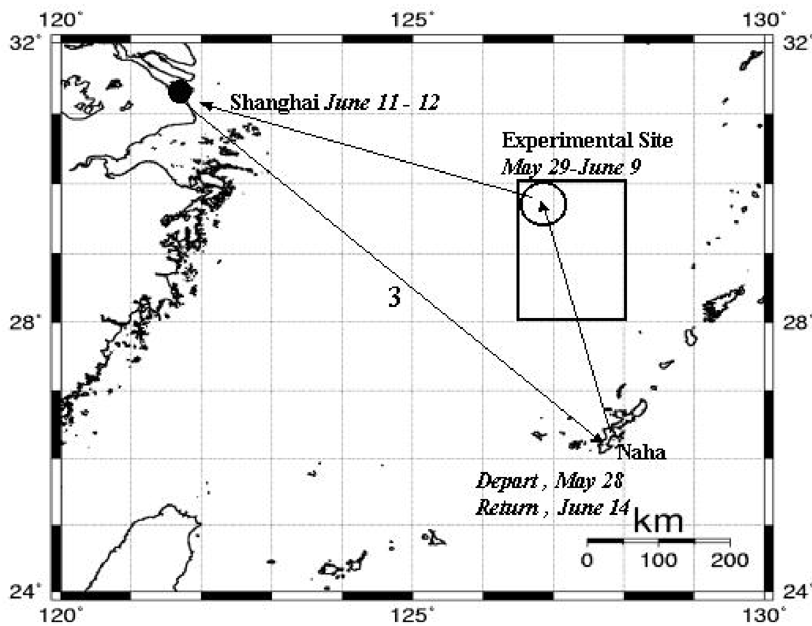


Figure 2. Cruise course for the R/V *Melville*. The majority of time at the experimental site was spent near the center of the 30-km radius circle shown. The rectangle delineates the research area approved by the State Oceanic Administration of the P. R. China.

The 30-km circle (Figure 2) was part of the planned survey course to be taken by the *Shi Yan 2*, and is discussed below. The rectangular box (Figure 2) shows the entire

area approved for research for the period 29 May to 9 June by the State Oceanic Administration (SOA) of the P. R. China. After completing work on 9 June, the *Melville* steamed to Shanghai. Upon arrival in Shanghai (11 June), officers from SOA boarded the *Melville* and met with the chief scientist to conduct a post-experiment inquiry into the nature and quantity of experimental measurements made.

In brief, ASIAEX ECS 2001 produced a remarkable set of measurements on acoustic propagation and scattering in an Asian littoral sea, along with environmental measurements required for its interpretation. These measurements will be thoroughly analyzed over the next two years by several investigators. The following sections (2–6) provide quick-look summaries of these measurements. The primary contact people associated with the different measurements are noted. Section 7 includes a listing of the scientific party and a record of the instrument deployments and recoveries.

2. ENVIRONMENTAL MEASUREMENTS: SOUND SPEED (*CONTACTS: MILLER AND POTTY*), SEA SURFACE DIRECTIONAL WAVE SPECTRA, AND WIND SPEED (*CONTACT: DAHL*)

A CTD team was set up at the beginning of the cruise to make sound speed measurements based on conductivity, depth, and temperature (CTD measurements) for use by all the participants in their acoustic simulation and modeling efforts; this team was led by Gopu Potty and Jim Miller. CTD casts to characterize sound speed variability were interleaved between deployments of other instruments. The CTD casts were made using either a Seabird 911 CTD deployed from the starboard A-frame, or if there was a cabling conflict, using MPL-SIO's Seabird seacat CTD deployed from the J-frame. An ensemble of CTD casts and their average (Figure 3) illustrate the typical variation in sound speed as function of depth for the experimental area. A contour of this data (Figure 4) shows how conditions changed over the course of the experiment. Variation linked with the tides (although aliased) is evident for the period 30 May to 2 June, and high winds are likely responsible for more water column mixing for the period 4–6 June.

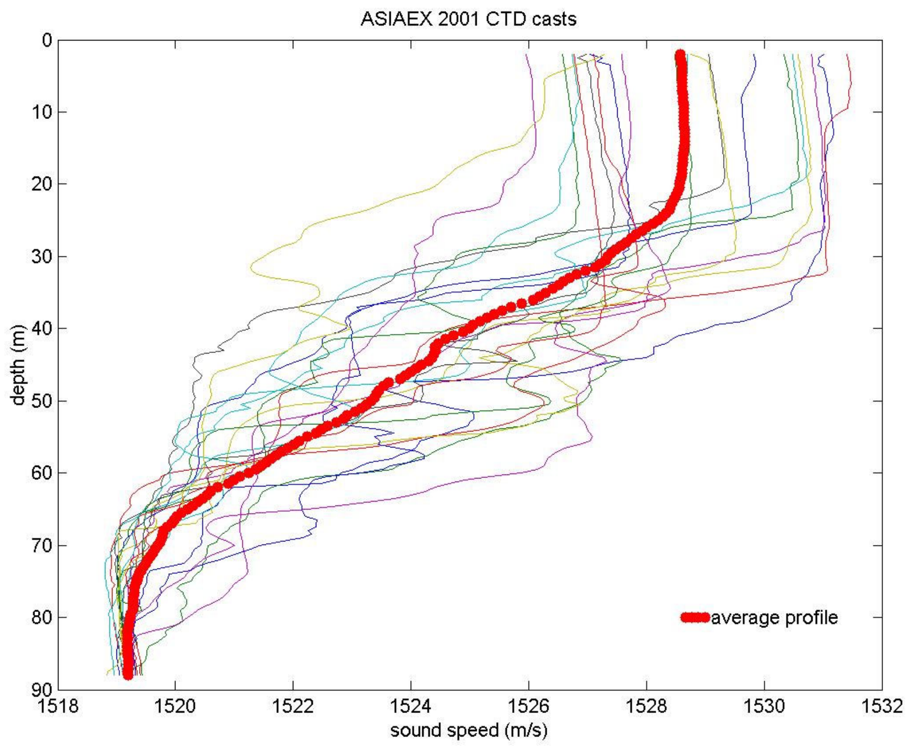


Figure 3. Envelope of CTD-derived sound speed profiles from several CTD casts and their average profile. (Note CTD casts were terminated at depth 90 m.)

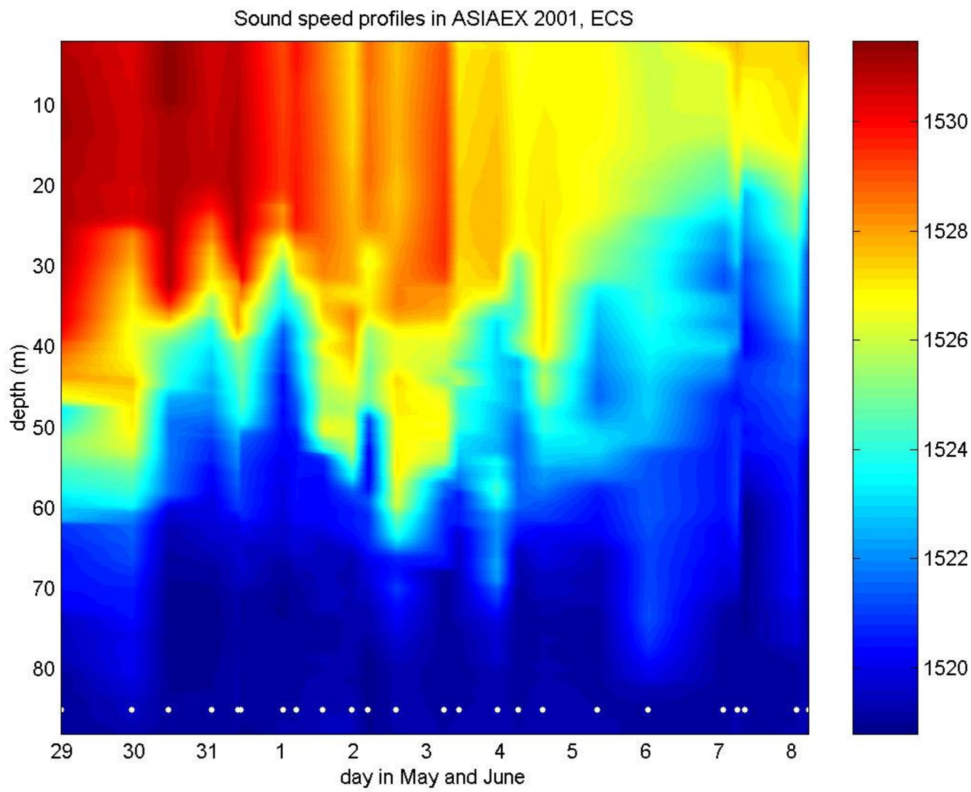


Figure 4. Sound speed profile calculated from 24 CTD casts made from the R/V *Melville*. The time of the casts is indicated by the white dots at the bottom of the figure.

The local sea state was measured using a 0.9-m diameter TRIAXYS directional wave buoy deployed by APL-UW. The directional wave buoy measured waveheight variance spectra in 0.005-Hz bins from 0.03 Hz to 0.64 Hz, and in 3-degree directional bins. Spectra were computed every 0.5 h based on a 20-min averaging time, and the data were sent back to the *Melville* via an RF modem link. The buoy was deployed on 29 May and operated until about 1600 on 8 June. Wind speed was measured using *Melville*'s IMET station. There were two high sea state events during the 9-day buoy deployment period, each lasting approximately 72 h (Figure 5).

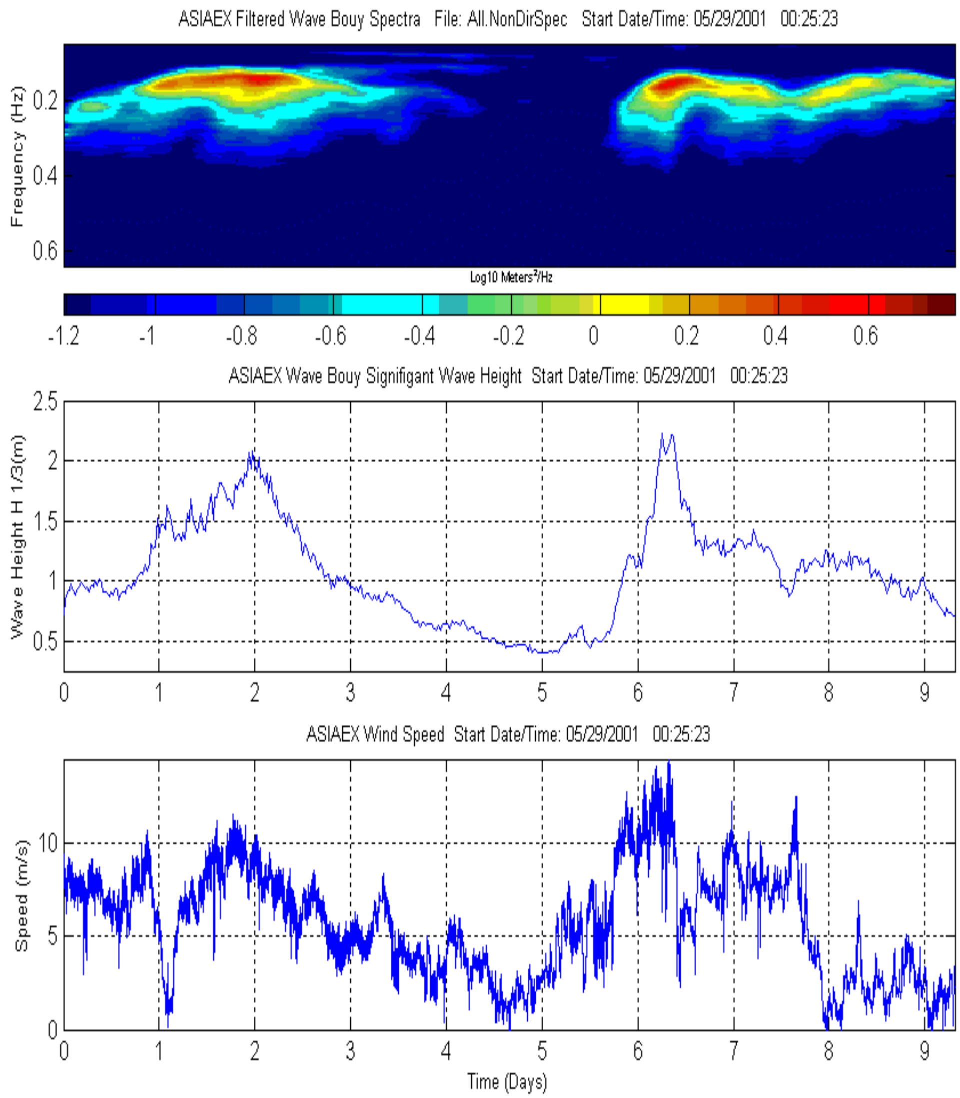


Figure 5. Time history of wind and sea waves made during ASIAEX 2001 East China Sea Experiment from the R/V *Melville*. The wind speed data were measured from the *Melville*'s IMET station. The wave data were measured with a directional wave buoy deployed by APL-UW.

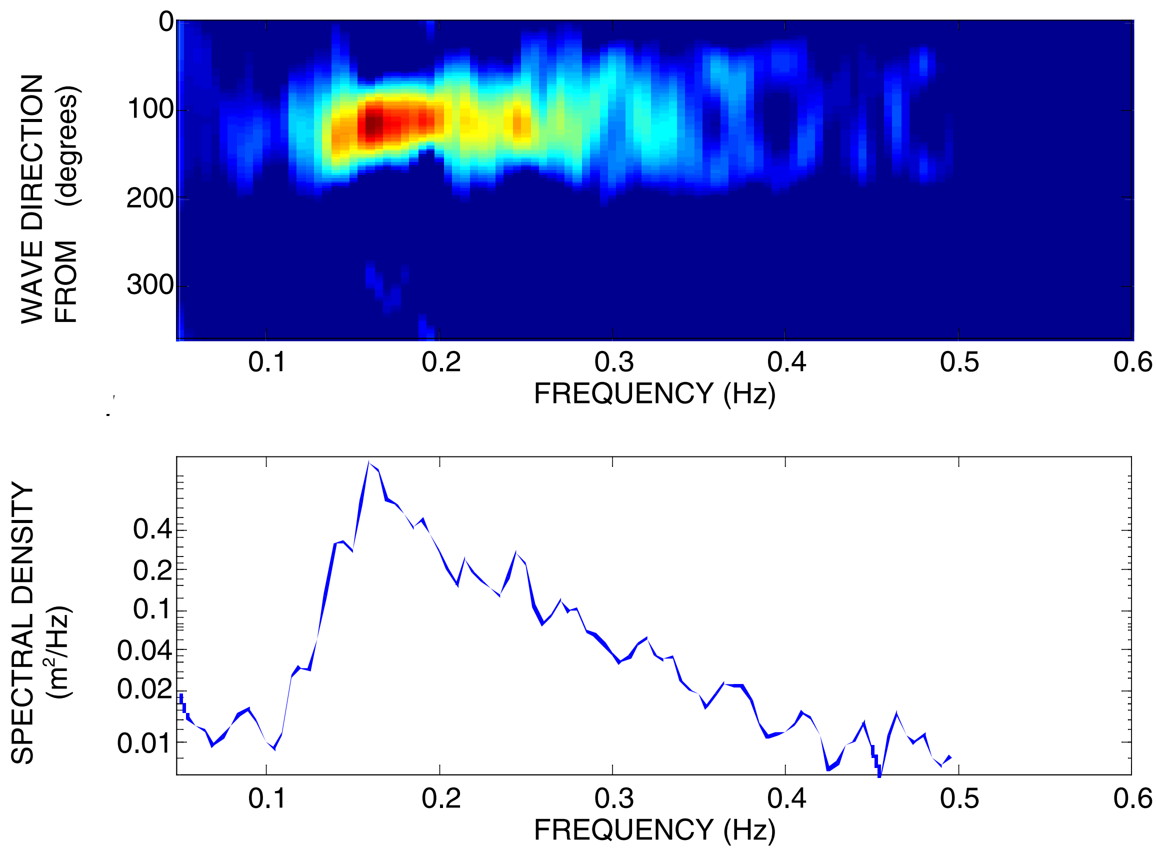


Figure 6. Two-dimensional directional wave spectrum showing wind-generated oriented in the same direction as the wind; the upper plot shows distribution of wave energy vs. frequency and direction, and the lower plot shows distribution vs. frequency. During the period of this measurement there were high easterly winds (> 12 m/s), producing waves from the same direction. The significant waveheight (computed here by taking four times the rms waveheight) is 1.9 m.

3. WIDE-BAND EXPLOSIVE SOURCE MEASUREMENTS USING APL-UW'S VERTICAL LINE ARRAY 'YELLOW SEA' MATED WITH URI'S DATA ACQUISITION SYSTEM (*CONTACTS: MILLER, POTTY, AND DAHL*)

The APL-UW vertical line array (VLA) 'Yellow Sea' consists of 16 elements (the 2 bottom elements were nonfunctional) spaced 4 m apart. This VLA was deployed from the *Melville*'s starboard J-frame and data were recorded on the URI multichannel data acquisition system.

The primary function of the 'Yellow Sea' array and URI system was to record the 38-g and 1000-g WBS deployed from the *Shi Yan 2* and *Shi Yan 3*. The WBS experiments were done in collaboration with Rehne Zhang from the Institute of Acoustics, Beijing, and Jixun Zhou from the Georgia Institute of Technology, Atlanta, both of whom were aboard the *Shi Yan 3*.

WBS experiments consisted of a propagation phase, during which sources were deployed from the *Shi Yan 2* while it steamed along a preset course (Figure 7), and a reverberation phase, during which sources were deployed from the *Shi Yan 3* which held position 2 n mi from the *Melville*. Interesting quick-look results from these experiments are represented in Figures 8–10. (Figures provided by Jim Miller and Gopu Potty.)

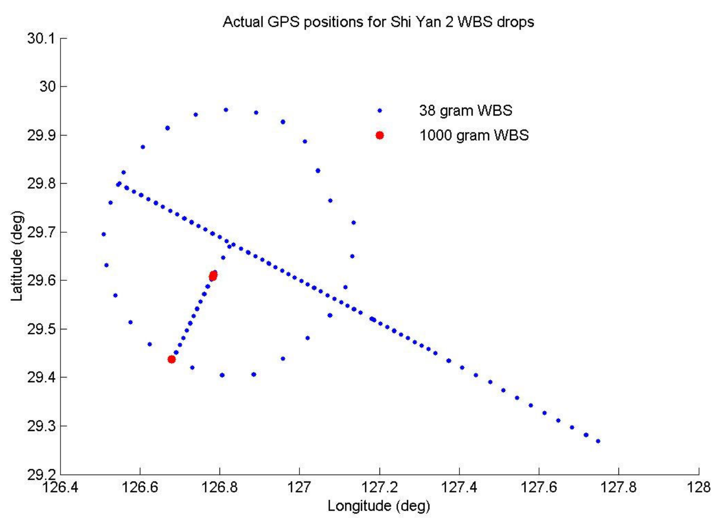


Figure 7. The *Shi Yan 2* dropped over 200 wide-band sources of two types (38 g and 1000 g). This figure depicts the actual WBS drop locations. The circle has a radius of 30 km, and is the same as shown in Figure 1. Positional data were obtained by Jim Miller while aboard the *Shi Yan 2*.

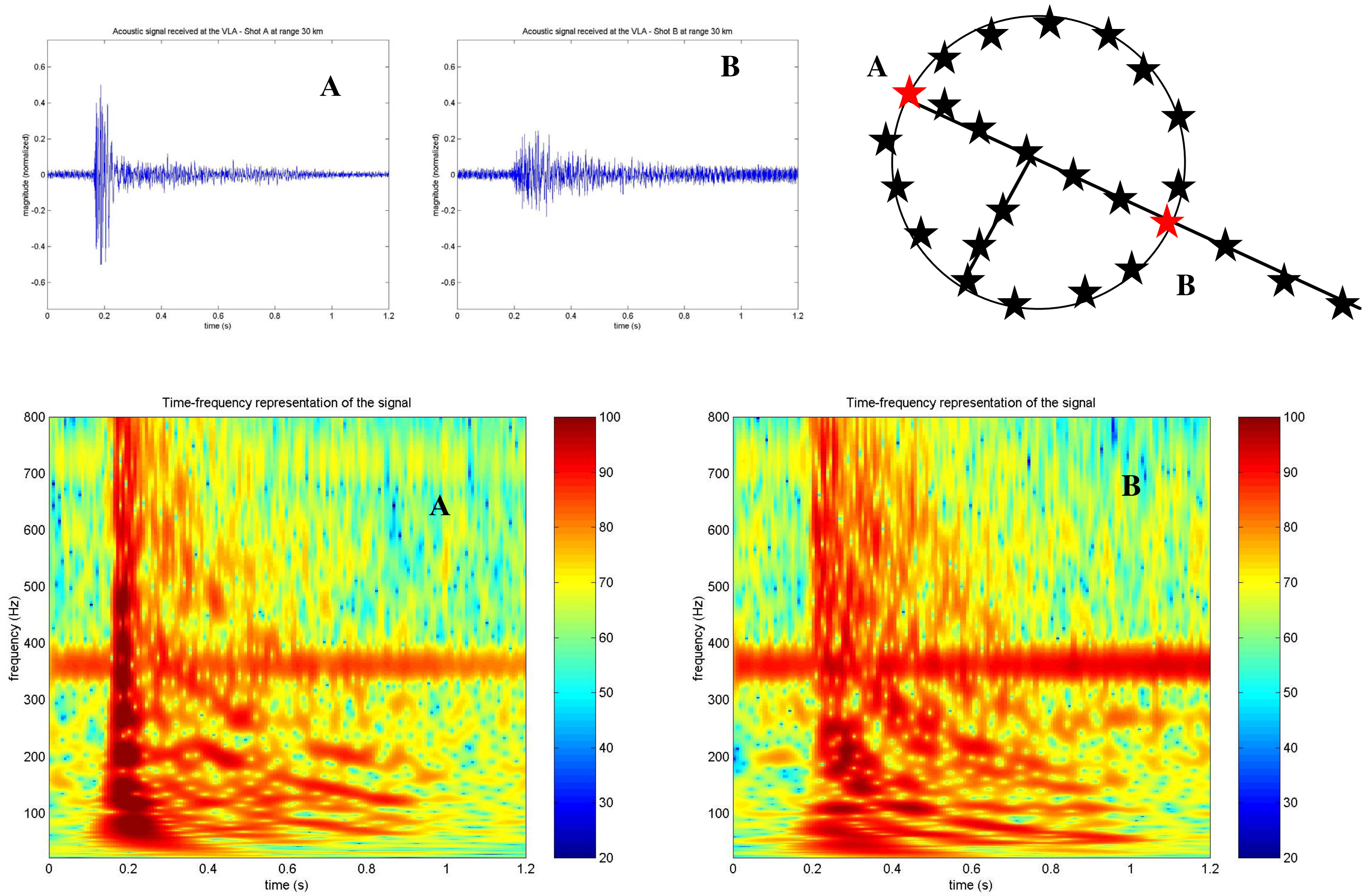


Figure 8. Acoustic signals received on the APL-UW 'Yellow Sea' array and recorded using the URI data acquisition system. The top panels show the time series from two WBS charges 'A' and 'B' and the bottom panels show the time-frequency diagrams. The time-frequency analysis was carried out using a wavelet-based approach. These signals were received at a hydrophone depth of 78.6 m. Both shots were 38-g WBS charges at 50-m depth deployed at 30 km from the receive array. Shot 'A' was on the NW side of the experimental area where the sediment is a soft mud-sand type. Shot 'B' was on the SE side, where high speed sandy sediments were present. The figure presents the comparison of dispersion of these signals over the same range. Water depth varies from 105 m at the NW corner to about 120 m at the SE corner. The initial arrival is stronger in Shot 'A' whereas the higher modes are more prominent in Shot 'B'. Up to nine modes can be identified in the dispersion diagram for Shot 'B'. Note that the actual depth at which the shots were deployed may be different for the two charges. The arrival times shown are arbitrary.

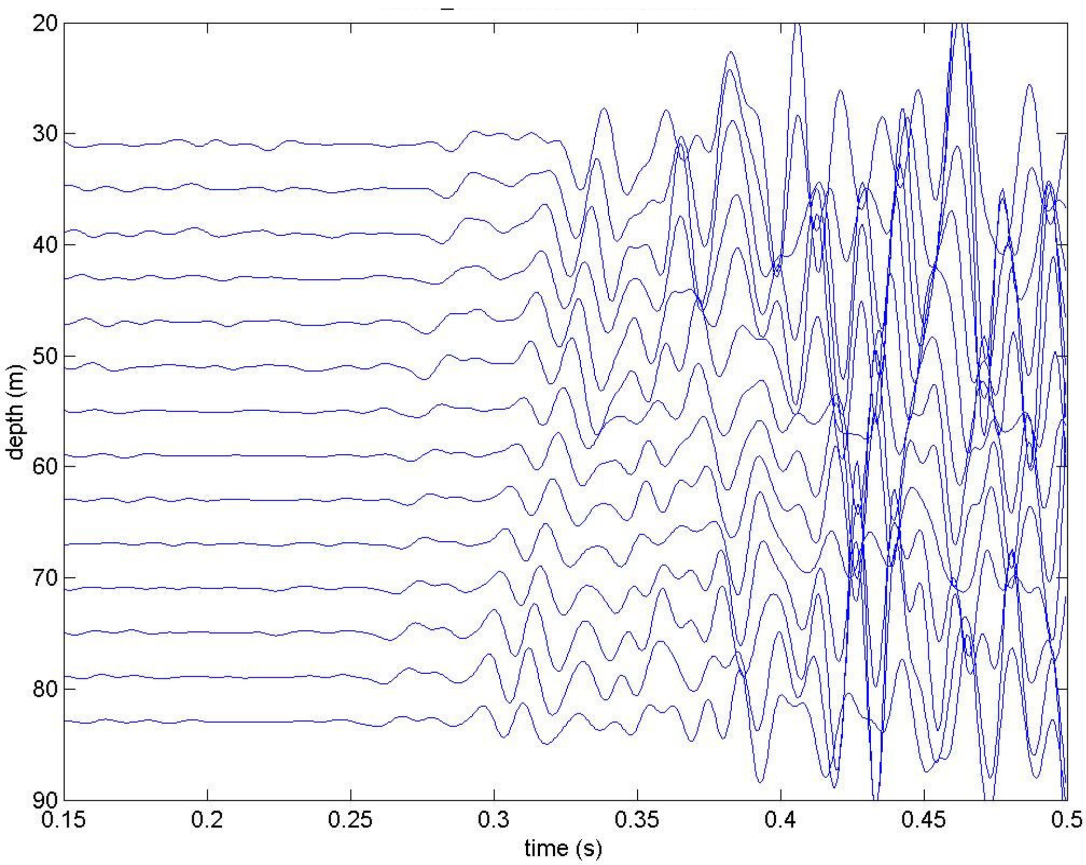
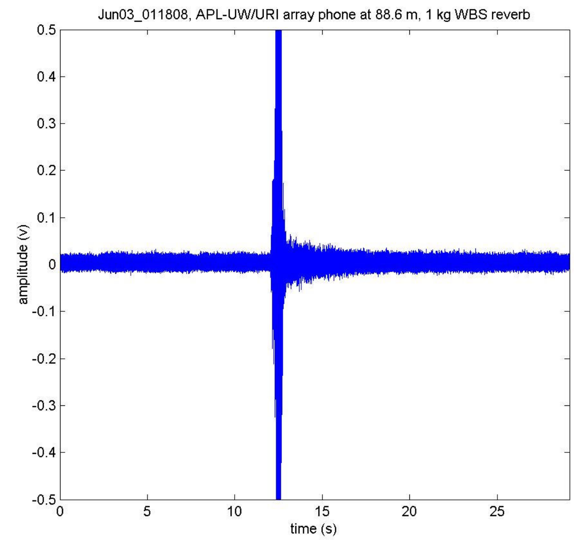


Figure 9. A head wave-like detection from a 1000-g WBS deployed from the *Shi Yan 3* as received on the APL-UW 'Yellow Sea' array and recorded using the URI data acquisition system. The range to source is 1.8 n mi. The pressure signal on each phone has been plotted centered around the depth of the hydrophone.

An example of wide-band (bistatic) reverberation is shown in Figure 10. Note that reverberation was also measured on a VLA deployed from the *Shi Yan 3*. Jixun Zhou and Rehne Zhang should be contacted for further information regarding data collected from the *Shi Yan 3*.



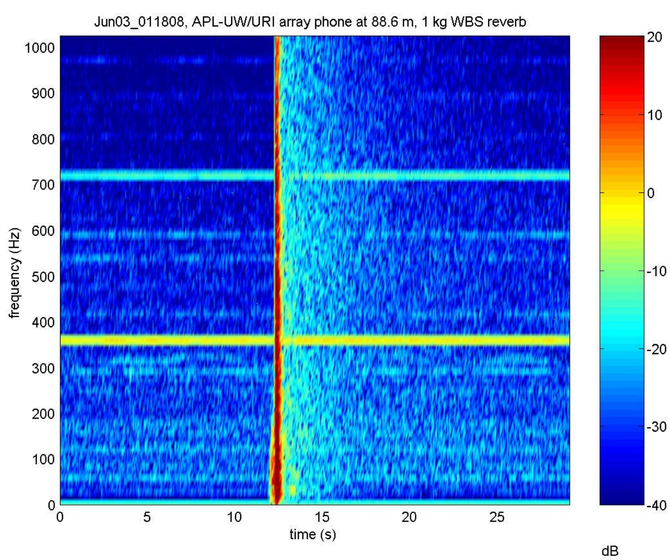


Figure 10. Panels represent the time series and spectrogram of a 1000-g WBS measured by the APL-UW/URI 'Yellow Sea' array, phone 14 at a depth of 88.6 m. The WBS was dropped by the *Shi Yan 3* at a range of 1.8 n mi. The reverberation from this shot could be discerned over a wide band of frequencies out to about 10 s after the direct arrival. The spectral lines at 360 Hz and 720 Hz are associated with the *Melville* power plant.

4. ACOUSTIC MEASUREMENTS WITH APL-UW'S BASS AND MORAY (*CONTACT: DAHL*)

BASS (Broad band Acoustic Source System) consists of a set of 3 transducers (ITC 2010, ITC 1007, and ITC 2044), capable of transmitting pulses over the frequency range 2–20 kHz. The BASS system was deployed off the stern of the *Melville* and the source depth was variable. MORAY (Moored Receiving Array) is an autonomous moored vertical line array, consisting of two, 4-element clusters. Element separation within each cluster is 13 cm, 30 cm, and 60 cm. For the ECS deployment, the upper cluster was placed at depth 26 m, and the lower cluster was placed at depth 52 m. (See Figure 11 for schematic representations of MORAY and BASS, and Figure 12 for a photograph of MORAY's surface expression shortly after deployment.)

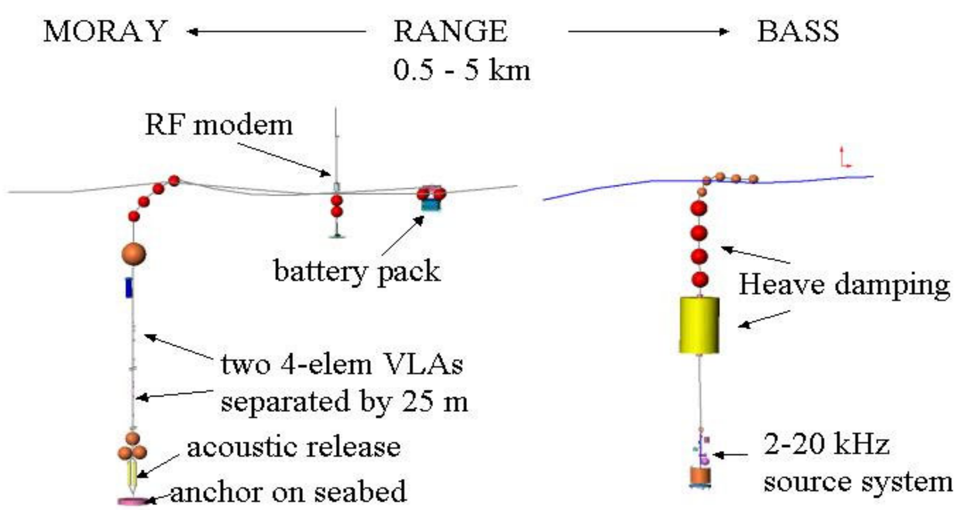


Figure 11. The BASS and MORAY systems.

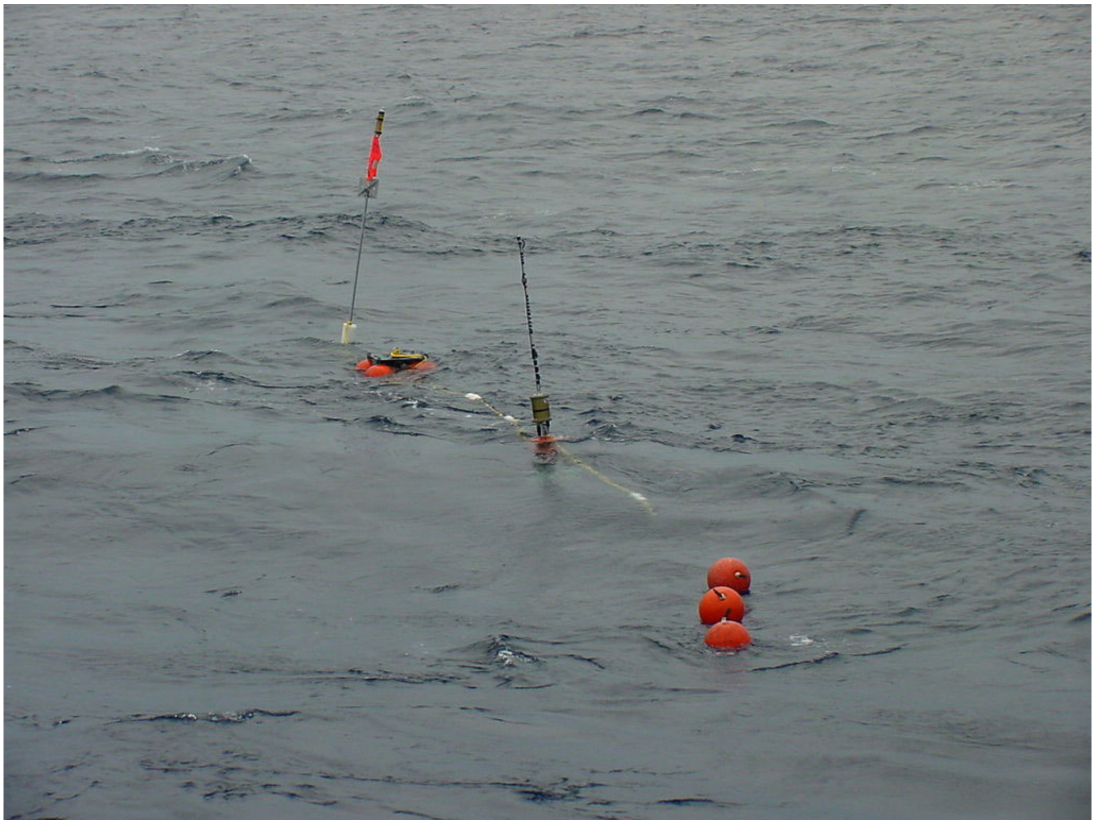


Figure 12. Photograph of surface antenna for RF modem (middle of picture), battery pack, and floats of the MORAY system.

BASS and MORAY were used for studies on shallow water, short-range propagation and forward scattering from the seabed and sea surface (time and angle spreading, coherent and incoherent intensity loss). Typical propagation conditions are illustrated by the ray diagram in Figure 13.

Two continuous measurement periods, each exceeding 24 h, were carried out in order to capture environmental effects in the data; records of ambient noise were also made during these periods. Additional measurements of shorter duration were also made at other times during the experiment. A typical suite of transmit pulses from BASS consisted of 2- and 3-ms CW pulses centered at 2, 4, 8, 16 and 20 kHz, followed by a 8–16 kHz, 20-ms FM pulse. Data recorded on MORAY were sampled at 50 kHz, and sent back to the *Melville* through an RF modem. Figures 14–15 illustrate some quick-look results of measurements made by the BASS and MORAY systems.

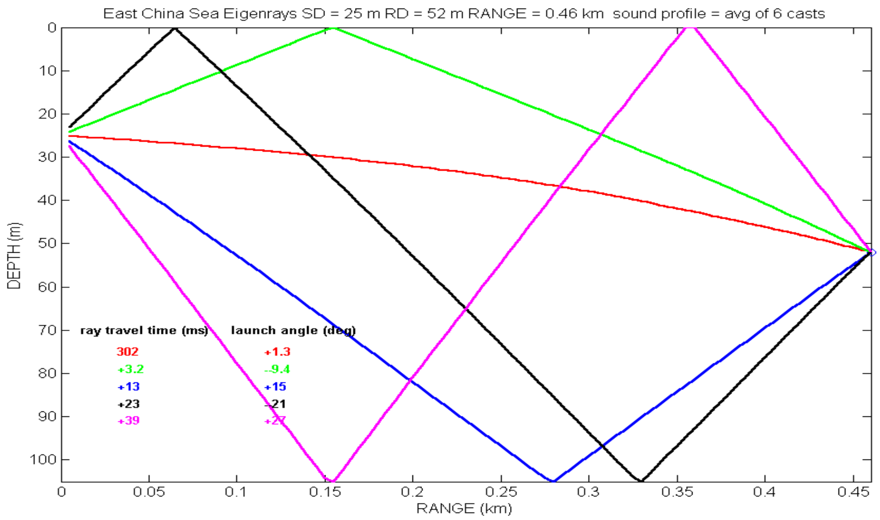


Figure 13. Plot of the first 5 eigenrays for an acoustic source at depth 25 m, receiver at depth 52 m and range 460 m, corresponding to one of the geometries used for BASS and MORAY. The average sound speed profile shown in Figure 3 was used in the program for computing rays.

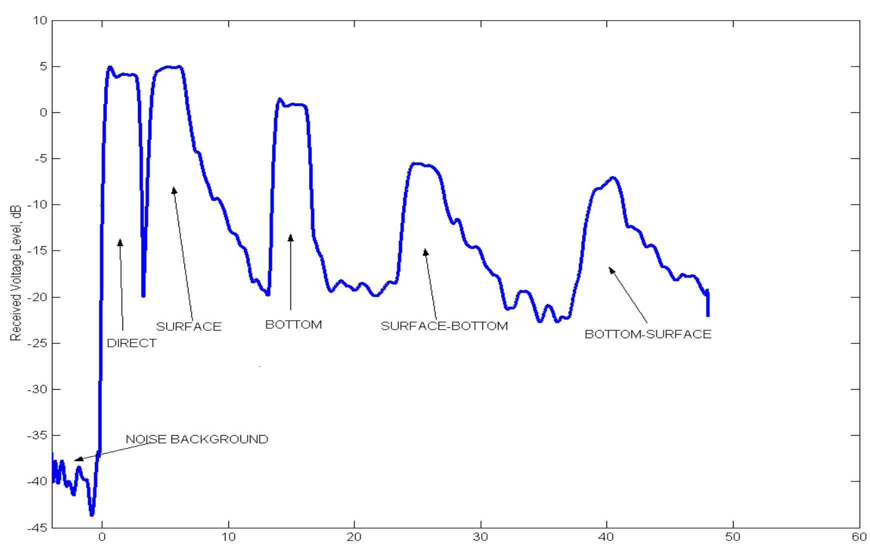


Figure 14. Ensemble-averaged squared voltage (proportional to intensity) of signal transmitted from BASS (2-ms CW, frequency 16 kHz) and received on the MORAY at depth 52 m. The primary arrivals are shown: direct path, surface bounce path, bottom bounce path, surface-bottom path, and bottom-surface path. These correspond closely to the five eigenrays in Figure 13.

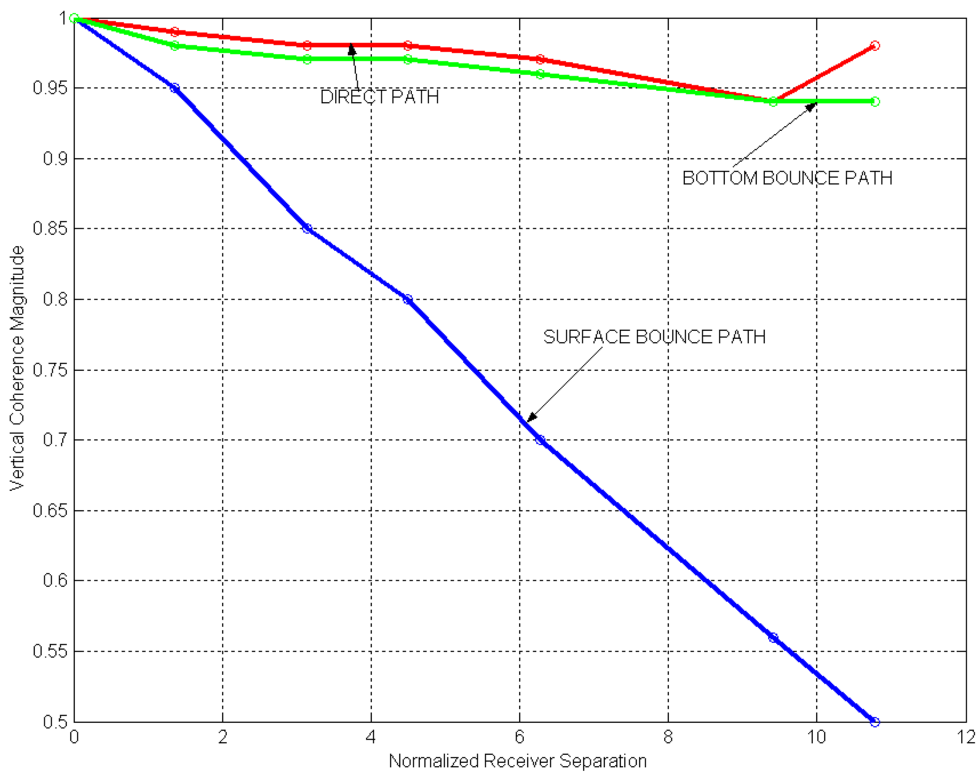


Figure 15. Vertical spatial coherence for the first three paths shown in Figure 14 plotted against receiver separation normalized by acoustic wavelength. Coherence for the sea surface bounce path was considerably reduced as a result of higher (vertical) angular spreading by the sea surface. In contrast, the spatial coherence for the bottom bounce path remained quite high over the length of the MORAY aperture, and suggests a relatively smooth seabed for length scales greater than about 4 times the acoustic wavelength.

5. MEASUREMENT OF FINE-SCALE BOTTOM PROPERTIES USING IMP2 (*CONTACT: TANG*)

The following text and figures were provided by DJ Tang. The IMP2 (In situ Measurement of Porosity, second generation) is designed to measure seafloor roughness and sub-bottom heterogeneity with cm-scale resolution. These data and the derived bottom roughness and sub-bottom density power spectra will be used as input to bottom acoustics scattering models. The IMP2 has a single conductivity probe mounted on a 5-m-long and 1.5-m-wide frame. The frame has both horizontal and vertical motor/encoder systems enabling the probe to take vertical measurements of conductivity across the seafloor with controlled depth steps. After each vertical measurement cycle is finished, the probe retracts to the starting position and the horizontal motor moves the probe to the next designated horizontal position, where the next vertical measurement cycle commences.

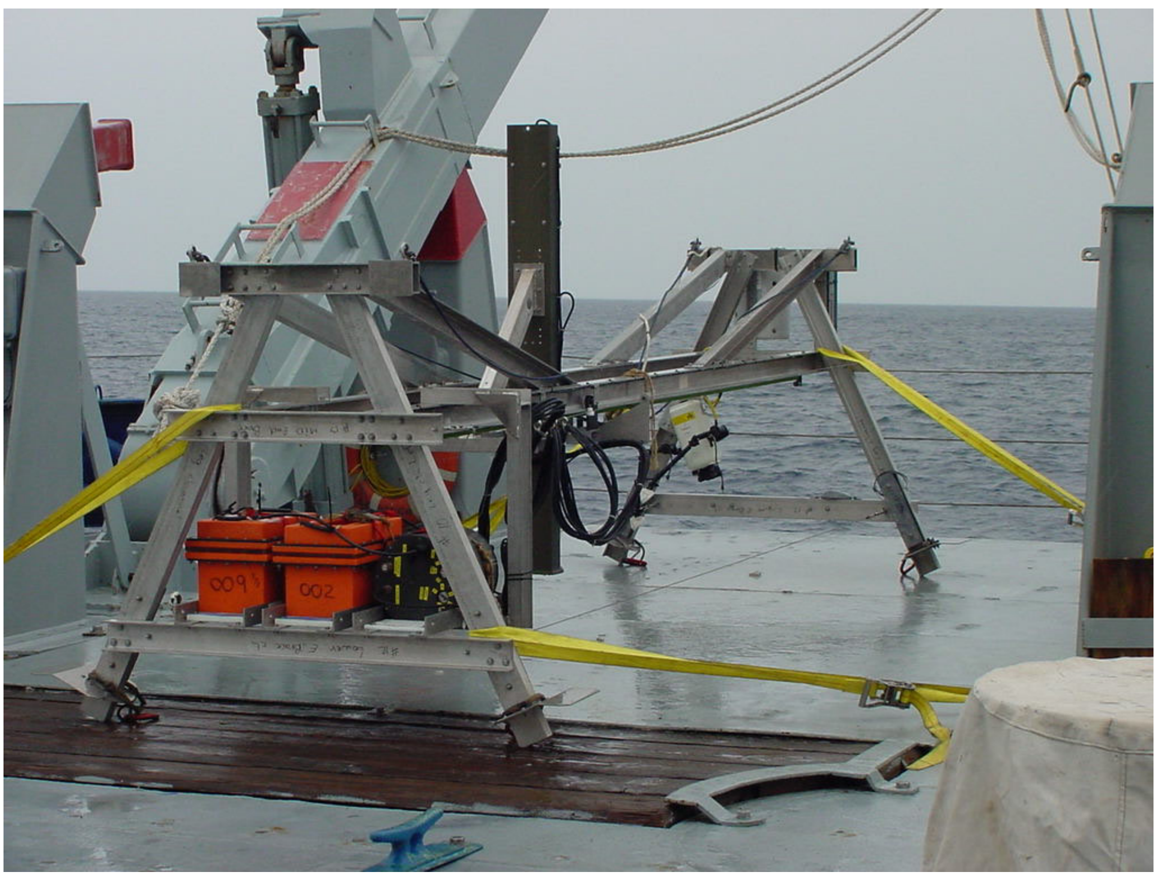


Figure 16. Photograph of IMP2 system prior to its deployment from *Melville*.

Deployments:

For all deployments, the vertical step used was **z** = 0.4 cm. The total depth **Z**, the horizontal step **r**, and horizontal length **L** vary.

May 31	29 39.118N, 126 48.804E	**r** = 2.5 cm, **L** = 172.5 cm, **Z** = 27.6 cm.
June 2	29 39.027N, 126 48.903E	**r** = 2.5 cm, **L** = 395.0 cm, **Z** = 15.0 cm.
June 5	29 39.031N, 126 48.856E	**r** = 1.5 cm, **L** = 395.0 cm, **Z** = 15.0 cm.

Examples of data collected are shown in Figures 17 and 18. Accompanying the last two deployments, a video camera and lights were attached to the frame. Analysis of the video data shows that the roughness apparent in Figure 18 was probably caused by bottom biological activities. Preliminary analysis of the data indicates that the seafloor was flat at meter scale with rms roughness around 1 cm or less.

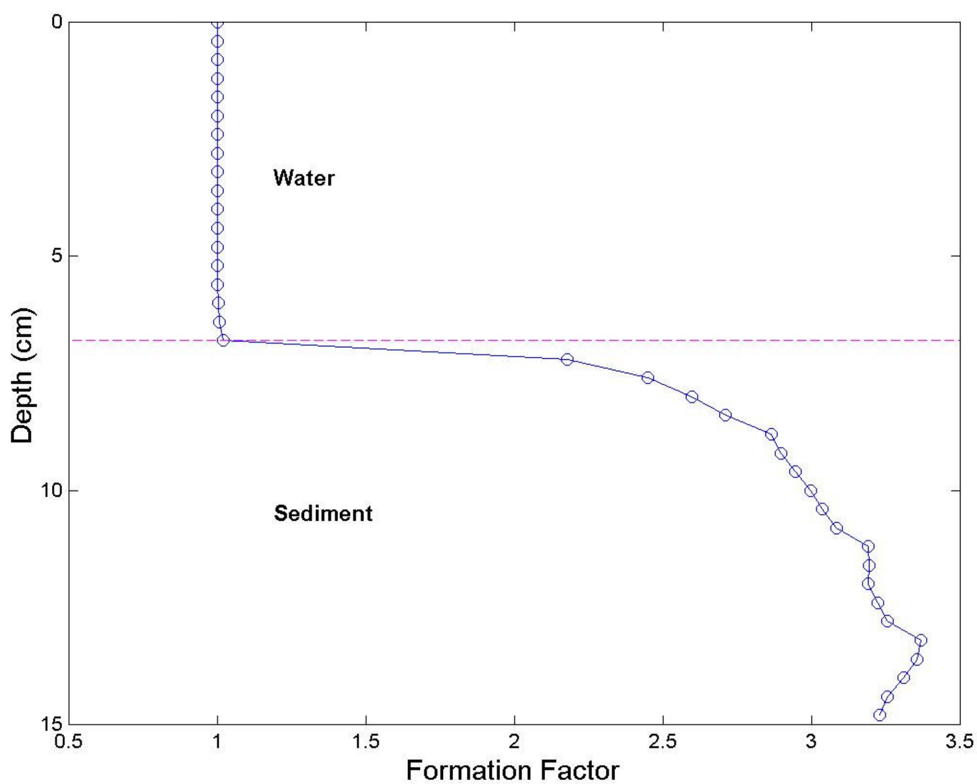


Figure 17. Typical formation factor from one vertical profile.

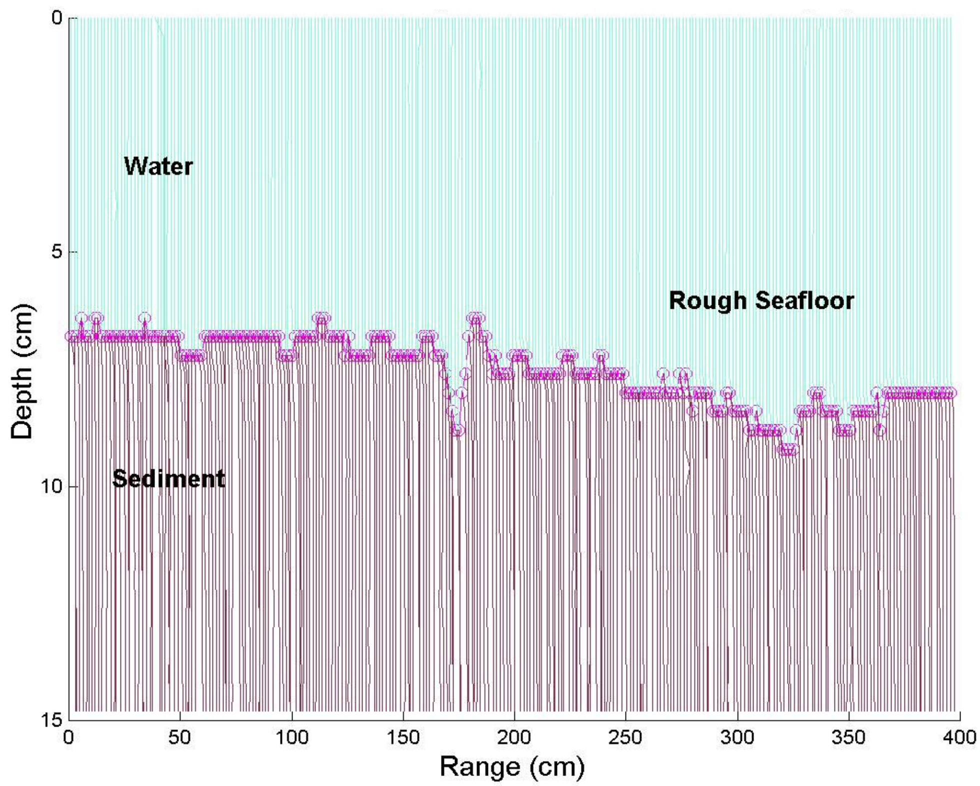


Figure 18. Data from one deployment showing the seafloor roughness. Formation factor and rough interface from 3rd IMP2 deployment.

6. STUDIES ON NARROW-BAND PROPAGATION AND REVERBERATION AT LOW FREQUENCY (100–1000 Hz), AND MID-FREQUENCY (1–5 kHz) (*CONTACT: HODGKISS*)

MPL-SIO conducted low- and mid-frequency propagation and reverberation studies described briefly below. (Text and figures provided by Bill Hodgkiss.)

850 Hz, Active

A 4-element, 850-Hz source array was deployed from the starboard A-frame to a depth of approximately 52 m (uppermost element). The array had a half-wavelength (0.88 m) interelement spacing with a total aperture of 2.64 m.

The receive array was the 16-element autonomous array deployed from the starboard J-frame to a depth of approximately 24.9 m (uppermost element). The array had an interelement spacing of 5 m with a total aperture of 75 m.

Recording Period:	JD 152 (1 June) 0903–1138 z
Transmissions:	CW (850 Hz): 10, 33, 100, 330, and 1000 ms
	Chirp (800–900 Hz): 100, 330, and 1000 ms

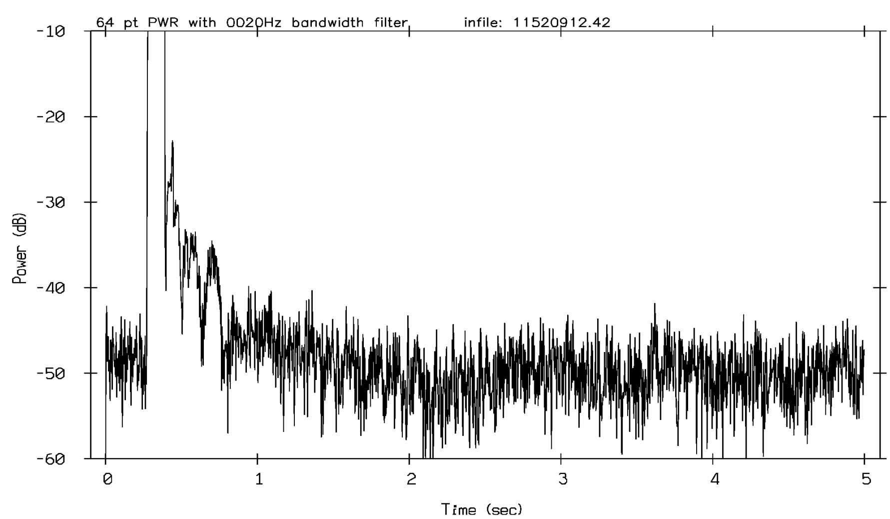


Figure 19. JD 152 (1 June) 091242 z. Reverberation received on a single element (#8) of the VLA from a 100-ms CW ping at 850 Hz.

3.5 kHz, Active

A 29-element source-receive array (VLA-29) was deployed from the starboard A-frame to a depth of 19.5 m (uppermost element). The array (Figure 20) had an interelement spacing of 2.79 m with a total aperture of 78 m.

Figure 20. Photograph of 29-element source-receive array.

Recording Period:	JD 150 (30 May) 0741–0830 z
Transmissions:	CW (3.5 kHz): 10 and 100 ms
	Chirp (3.0–4.0 kHz): 100 and 1000 ms

Recording Period:	JD 153 (2 June) 0722–1201 z
Transmissions:	CW (3.5 kHz): 10, 33, 100, 330, and 1000 ms
	Chirp (3.0–4.0 kHz): 100, 330, and 1000 ms

Recording Period:	JD 159 (8 June) 0329–0736 z
Transmissions:	CW (3.5 kHz): 10, 33, 100, 330, and 1000 ms
	Chirp (3.0–4.0 kHz): 100, 330, and 1000 ms

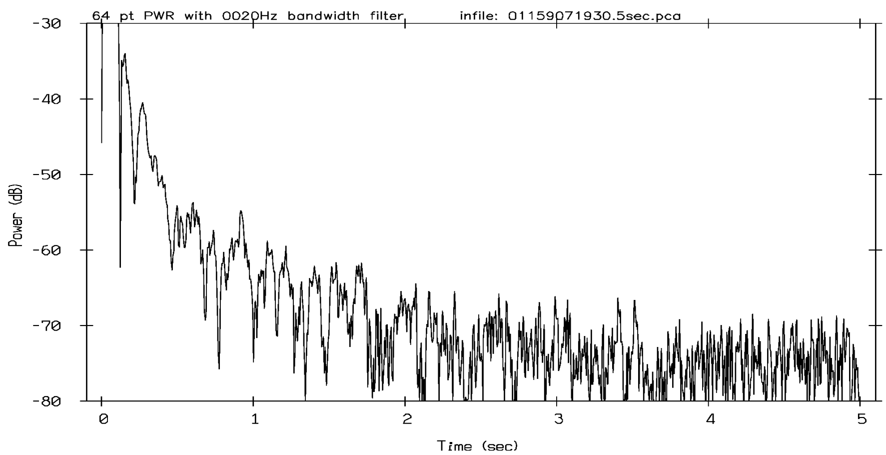


Figure 21. JD 159 (8 June) 071930 z. Reverberation received on a single element (#15) of the source-receive array from a 100-ms CW ping at 3.5 kHz.

Autonomous Receive Array and Source Tow

A 16-element, autonomous receive array was deployed to collect source tow data. The array (Figure 22) had an interelement spacing of 5 m with a total aperture of 75 m. The uppermost element was at a depth of approximately 24.5 m.

Recording Period:	JD 155 (4 June) 0102 z – JD 156 (5 June) 0233 z
Recording Period:	JD 155 (4 June) 1340–1455 z
Transmissions:	J-15 source: 95, 195, 295, 395, 805, 850, and 895 Hz
Recording Period:	JD 158 (7 June) 0013–1014 z
Recording Period:	JD 158 (7 June) 0310–0436 z
Transmissions:	J-15 source: 95, 195, 295, 395, 805, 850, and 895 Hz
Recording Period:	JD 158 (7 June) 0600–0725 z
Transmissions:	ITC-2015 source: 1.6, 2.4, 3.5, and 4.4 kHz
Recording Period:	JD 158 (7 June) 0905–0937 z
Transmissions:	J-15 source: 95, 195, 295, 395, 805, 850, and 895 Hz

Figure 22. Photograph of 16-element, autonomous receive array.

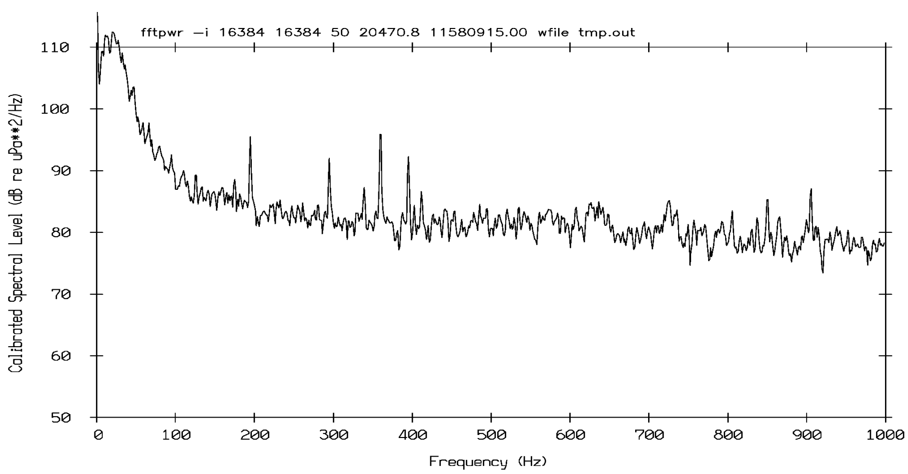


Figure 23. JD 158 (7 June) 091500 z. Transmissions from the J-15 source tow received on the VLA (element #8). The frequencies transmitted were 95, 195, 295, 395, 805, 850, and 895 Hz.

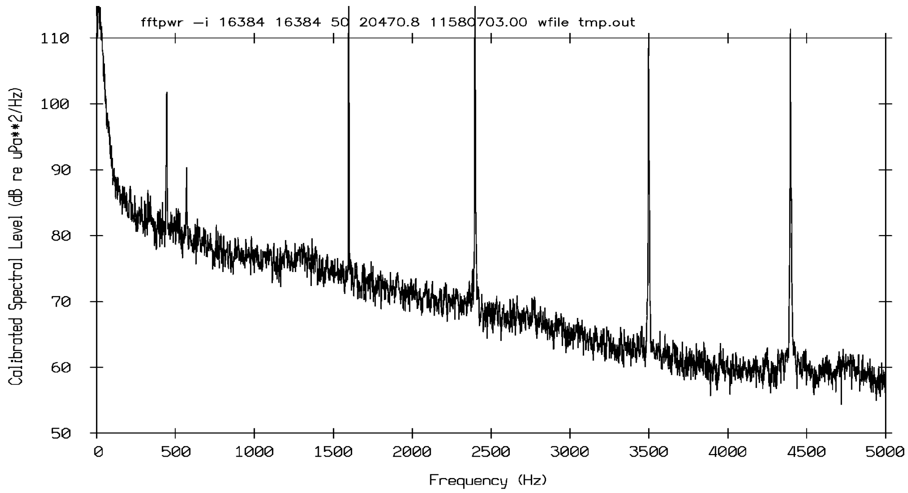


Figure 24. JD 158 (7 June) 070300 z. Transmissions from the ITC-2015 source tow received on the VLA (element #8). The frequencies transmitted were 1.6, 2.4, 3.5, and 4.4 kHz.

7. SCIENCE PARTY AND LOG OF DEPLOYMENTS AND RECOVERIES

Table I. List of contact persons for measurements discussed in Sections 2–6.

Contact	Institution	E-mail Address
Peter Dahl	Applied Physics Laboratory-UW	dahl@apl.washington.edu
Bill Hodgkiss	Marine Physical Laboratory-SIO	wsh@mpl.ucsd.edu
James Miller	University of Rhode Island	miller@egr.uri.edu
Gopu Potty	University of Rhode Island	potty@oce.uri.edu
Dajun Tang	Applied Physics Laboratory-UW	djtang@apl.washington.edu
Rehne Zhang	Institute of Acoustics, Beijing	zrh@farad.ioa.ac.cn
Jixun Zhou	Georgia Institute of Technology	jixun.zhou@me.gatech.edu

Table II. Science party aboard the R/V *Melville*.

Name	Title	Institution
Shad Baiz	Resident Technician	SIO
Eric Boget	Engineer	Applied Physics Laboratory-UW
Peter Dahl	Chief Scientist and PI	Applied Physics Laboratory-UW
Feng Ding	Engineer	HAARI, Hangzhou, P. R. China
Dave Ensberg	Engineer	Marine Physical Laboratory-SIO
Dick Harriss	Engineer	Marine Physical Laboratory-SIO
Bill Hodgkiss	Scientist and PI	Marine Physical Laboratory-SIO
Russ Light	Engineer	Applied Physics Laboratory-UW
James Miller	Scientist and PI	University of Rhode Island
Vern Miller	Engineer	Applied Physics Laboratory-UW
Ron Moe	Computer Technician	SIO
Gopu Potty	Scientist	University of Rhode Island
Pete Sabin	Engineer	Applied Physics Laboratory-UW
Jeff Skinner	Engineer	Marine Physical Laboratory-SIO
Hee Chung Song	Scientist	Marine Physical Laboratory-SIO
Dajun Tang	Scientist and PI	Applied Physics Laboratory-UW
Zhongkang Wang	Engineer	HAARI, Hangzhou, P. R. China
Lixun Wu	Science Observer	Institute of Acoustics, Beijing, P. R. China
Jin Yan	Science Observer	Institute of Acoustics, Beijing, P. R. China
Kunde Yang	Science Observer	Northwestern PolyTechinal. University Xi'an, P. R. China

Table III. Log of instrument deployments and recoveries from R/V *Melville* during ASIAEX ECS 2001. Note: this log is based on original entries made by *Melville* deck officers on duty at the time (their initials are AM, JH and DKK). This log was updated whenever an instrument was deployed or recovered, with positional data recorded automatically. Entries have been modified slightly by P. H. Dahl in the following manner: (1) Some log entries (i.e., rows) that pertain to the progress of a particular deployment or recovery have been removed, such that in general there is only one entry for deployment and one entry for a recovery, and for CTDs, only deployment times are listed; (2) Small changes were made in the "Operation" column to maintain consistency in nomenclature; (3) Rows that denote various phases or events of the experiment are inserted; (4) "*log mark*" inserted for cross referencing with other documents.

Date (GMT)	Time (GMT)	Latitude	Longitude	Operation
05/27/2001	2330z	26 12.55N.	127 40.00E.	Depart Naha, Japan AM
05/28/2001	2237z	29 39.13N.	126 48.89E.	Wave buoy deployed JH
05/28/2001	2342z	29 39.12N.	126 48.94E.	CTD#1 deployed DKK
05/29/2001	0427z	29 39.023N.	126 48.718E.	MORAY deployed AM
05/29/2001	0459z	29 39.107N.	126 48.859E.	VLA-16 deployed AM
VLA –16 deployed for short test				
05/29/2001	0653z	29 39.141N.	126 48.706E.	VLA 16 on deck JH
05/29/2001	1015z	29 39.030N.	126 48.732E.	Recovering MORAY JH
05/29/2001	1139z	29 39.038N.	126 48.722E.	MORAY Deployed DKK
MORAY CPU card failure, system recovered and repaired overnight				
05/29/2001	2306z	29 39.156N.	126 48.794E.	CTD#2 deployed JH (***log mark 1***)
05/30/2001	0203z	29 39.104N.	126 48.820E.	IMP deployed DKK (#1)
05/30/2001	0610z	29 39.246N.	126 48.582E.	VLA-29 deployed AM
05/30/2001	0914z	29 39.144N.	126 48.734E.	VLA-29 on deck JH
05/30/2001	1003z	29 39.093N.	126 48.767E.	CTD#3 deployed JH
05/30/2001	1147z	29 39.133N.	126 48.764E.	Recovered IMP DKK
05/30/2001	2354z	29 39.070N.	126 48.709E.	Deployed MORAY DK
MORAY re-deployed				
05/31/2001	0033z	29 39.115N.	126 48.688E.	CTD #4 deployed DK
05/31/2001	0250z	29 39.264N.	126 48.787E.	BASS deployed DK
Begin a 24-h experiment using BASS and MORAY; nominal range = 500 m; pulse type = 2 and 3 ms CW at 2, 4, 8, 16, and 20 kHz, 20 ms 8–16 kHz FM; source depth =25 m				
05/31/2001	0606z	29 39.301N.	126 48.813E.	CTD #5 deployed AM

05/31/2001	0710z	29 39.279N.	126 48.836E.	YSA deployed at 67 m AM
Yellow Sea array deployed for short test				
05/31/2001	1024z	29 39.261N.	126 48.828E.	YSA on deck JH
05/31/2001	1035z	29 39.263N.	126 48.828E.	CTD #6 deployed JH
06/01/2001	0015z	29 39.278N.	126 48.789E.	CTD #7 deployed DK
06/01/2001	0434z	29 39.297N.	126 48.823E.	CTD #8 deployed AM
06/01/2001	0645z	29 39.282N.	126 48.835E.	BASS on deck AM
BASS recovered after 24-h BASS-to-MORAY transmission				
06/01/2001	0742z	29 39.288N.	126 48.834E.	VLA-16 deployed AM
06/01/2001	0830z	29 39.257N.	126 48.819E.	850-Hz source deployed JH
VLA-16 plus 850-Hz source are deployed for 850-Hz NB reverberation measurements				
06/01/2001	1154z	29 39.264N.	126 48.793E.	Recovered 850-HZ source DK
06/01/2001	1205z	29 39.267N.	126 48.792E.	Recovered VLA-16 array DK
06/01/2001	1231z	29 39.273N.	126 48.790E.	CTD #9 deployed DK
06/01/2001	2300z	29 39.235N.	126 48.690E.	CTD #10 deployed JH
06/02/2001	0424z	29 38.768N.	126 48.521E.	CTD #11 deployed AM
06/02/2001	0511z	29 38.828N.	126 48.549E.	VLA-29 deployed AM
VLA-29 deployed for 3–4 kHz reverberation measurements (***log mark 2***)				
06/02/2001	1235z	29 38.805N.	126 48.572E.	VLA-29 on deck DK
06/02/2001	1311z	29 39.014N.	126 48.889E.	Deployed IMP DK (#2)
06/02/2001	1332z	29 38.981N.	126 48.861E.	CTD #12 deployed DK
06/02/2001	2128z	29 38.995N.	126 48.894E.	Recovered IMP JH
06/02/2001	2240z	29 38.757N.	126 48.680E.	Deployed YSA JH
URI system and YSA on standby, waiting for 3 1000-g WBS deployed from *SY3*. After this, the *SY2* will start its outbound course from *SY3* while deploying 38-g WBS				
06/03/2001	0540z	29 38.783N.	126 48.706E.	CTD #13 deployed AM
06/03/2001	0645z	29 38.776N.	126 48.725E.	HAARI array deployed at 7 m AM
Test deployment of the HAARI VLA (***log mark 3***)				
06/03/2001	1006z	29 38.745N.	126 48.716E.	HAARI array on deck JH
06/03/2001	1030z	29 38.743N.	126 48.712E.	CTD #14 deployed JH
06/03/2001	2310z	29 38.735N.	126 48.719E.	CTD #15 deployed JH
06/04/2001	0035z	29 38.853N.	126 48.571E.	Recovered YSA DK
WBS propagation experiment is completed				
06/04/2001	0205z	29 38.776N.	126 48.687E.	Deployed VLA-16 DK
VLA-16 deployed as an autonomous receiving array mooring				
06/04/2001	0526z	29 38.592N.	126 48.421E.	CTD #16 deployed AM

06/04/2001	0610z	29 38.526N.	126 48.511E.	LF source (J-15) deployed AM
Melville towing MPL LF source (***log mark 4***)				
06/04/2001	2321z	29 38.765N.	126 48.732E.	LF source (J-15) on deck JH
06/04/2001	2330z	29 38.768N.	126 48.736E.	CTD #17 deployed JH
06/04/2001	1325z	29 38.554N.	126 48.230E.	LF source (J-15) deployed DK
Melville towing MPL LF source				
06/04/2001	1507z	29 41.673N.	126 48.476E.	LF source (J-15) on deck DK
06/05/2001	0043z	29 38.733N.	126 48.338E.	YSA deployed DK
YSA deployed for reverberation measurements using WBS deployed from *Shi Yan 3*. *SY3* position: 29 40.47N., 126 49.03E.				
06/05/2001	0619z	29 38.765N.	126 48.367E.	YSA on deck AM
06/05/2001	0702z	29 38.714N.	126 48.519E.	VLA-16 on deck AM
VLA-16 mooring recovered approximately 1 h after the WBS experiment was recorded				
06/05/2001	0750z	29 38.849N.	126 48.841E.	CTD #18 deployed JH
06/05/2001	1700z	29 39.008N.	126 48.425E.	BASS array deployed JH
Begin a 24-h experiment using BASS and MORAY; nominal range = 500 m; pulse type = 2 and 3 ms CW at 2, 4, 8, 16, and 20 kHz, 20 ms 8–16 kHz FM; source depth = 50 m				
06/06/2001	0026z	29 38.774N.	126 48.801E.	CTD #19 deployed DK
06/06/2001	0418z	29 38.793N.	126 48.780E.	HAARI array deployed at 100 m AM
Mid-frequency reverberation measurements using HAARI VLA (***log mark 5***)				
06/06/2001	0636z	29 38.872N.	126 48.802E.	BASS array on deck AM
06/06/2001	0734z	29 38.906N.	126 48.761E.	HAARI array on deck AM
06/06/2001	1030z	29 39.006N.	126 48.937E.	Deployed IMP JH (#3)
06/06/2001	2030z	29 38.983N.	126 48.771E.	Recovered IMP
06/07/2001	0105z	29 38.991N.	126 48.919E.	CTD #20 deployed DK
06/07/2001	0214z	29 38.963N.	126 48.897E.	VLA 16 deployed DK
06/07/2001	0304z	29 38.778N.	126 48.658E.	LF source deployed @ 80M DK
Melville towing MPL LF source				
06/07/2001	0445z	29 40.752N.	126 46.085E.	LF source on deck AM
06/07/2001	0531z	29 38.826N.	126 48.438E.	CTD #21 deployed AM
06/07/2001	0555z	29 38.833N.	126 48.432E.	MF source deployed AM
Melville towing MPL MF source				
06/07/2001	0727z	29 40.499N.	126 46.699E.	MF source on deck AM
06/07/2001	0805z	29 38.887N.	126 48.515E.	CTD #22 deployed JH
06/07/2001	0840z	29 38.776N.	126 48.634E.	Wave buoy on deck JH
06/07/2001	0855z	29 38.911N.	126 48.602E.	LF source deployed JH

06/07/2001	0948z	29 39.669N.	126 46.979E.	LF source on deck JH
06/07/2001	1030z	29 38.943N.	126 48.959E.	VLA-16 on deck JH
06/07/2001	1115z	29 39.057N.	126 48.786E.	HAARI array deployed JH
06/07/2001	2252z	29 39.079N.	126 48.875E.	HAARI array on deck JH
06/08/2001	0041z	29 39.122N.	126 48.773E.	Recovered wave buoy mooring DK
06/08/2001	0102z	29 39.149N.	126 48.790E.	CTD #23 deployed DK
06/08/2001	0320z	29 39.154N.	126 48.717E.	VLA-29 deployed @ 95M DK
VLA-29 (source)–MORAY (receiver) experiment using 3.5 kHz 2 ms CW and 3–4 kHz 100 ms FM				
06/08/2001	0500z	29 39.158N.	126 48.718E.	CTD #24 deployed AM
06/08/2001	0800z	29 39.149N.	126 48.714E.	VLA-29 on deck JH
06/08/2001	1000z	29 39.014N.	126 48.654E.	MORAY on deck JH
06/08/2001	1006z	29 39.013N.	126 48.636E.	CTD #25 deployed JH
Below is a series of four waypoints for a bottom survey using 2–7-kHz chirp sonar				
06/09/2001	0709z	29 40.381N.	126 55.619E.	at WP #1 commence survey AM
06/09/2001	0756z	29 44.294N.	126 47.141E.	at WP#2 C/C to 209T JH
06/09/2001	0820z	29 41.017N.	126 44.494E.	at WP#3 C/C to 118T JH
06/09/2001	0903z	29 36.274N.	126 52.569E.	at WP#4 C/C to 104T JH
Below is a series of 7 CTDs taken along a single transect. Start new numbering sequence.				
06/09/2001	1016z	29 33.312N.	127 05.904E.	CTD #1 deployed JH
06/09/2001	1105z	29 35.832N.	127 00.577E.	CTD #2 deployed JH
06/09/2001	1149z	29 38.256N.	126 55.056E.	CTD #3 deployed DK
06/09/2001	1243z	29 41.477N.	126 50.239E.	CTD #4 deployed DK
06/09/2001	1343z	29 43.143N.	126 44.117E.	CTD #5 deployed DK
06/09/2001	1442z	29 45.637N.	126 38.142E.	CTD #6 deployed DK
06/09/2001	1532z	29 48.246N.	126 32.861E.	CTD #7 deployed DK
06/11/2001	0412z	31 14.884N.	121 29.595E.	Arrive Shanghai AM
06/12/2001	0718z	31 14.886N.	121 29.593E.	Depart Shanghai AM
06/13/2001	0054z	29 35.425N.	124 24.760E.	Arrive Naha AM

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Peter H. Dahl

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Applied Physics Laboratory
University of Washington
1013 NE 40th Street
Seattle, WA 98105-6698

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13. ABSTRACT *(Maximum 200 words)*

Science teams from APL-UW, MPL-SIO, and URI deployed a constellation of instruments from the R/V *Melville* to measure acoustic propagation and scattering over a broad frequency range (100 Hz to 20kHz), and environmental acoustic variables in the East China Sea (ECS). This work was completed from 29 May 2001 to 9 June 2001 as part of the Asian Seas International Acoustic Experiment (ASIAEX). From 2 to 5 June, operations from the *Melville* were coordinated with those of the Chinese research vessels *Shi Yan 2* and *Shi Yan 3* in order to conduct studies in wide-band propagation and reverberation using explosive charges deployed from both Chinese vessels. The ASIAEX ECS 2001 experiment produced a remarkable set of measurements on acoustic propagation and scattering in an Asian littoral sea, along with environmental measurements required for its interpretation.

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